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EXPERIMENTAL INVESTIGATION OF RETARDED
UNSTEADY TURBULENT BOUNDARY LAYERS

by

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PROGRESS REPORT :

Improvements of apparatus

1. The construction of the calibration facility and of the carriage for hot film probes has been finished
2. The software for the data acquisition system (OLIVETTI M240 micro-computer with ANALOG DEVICE interface) has been written and tested. Data acquisition with a sampling rate up to 10 kHz can be performed. (France, jld)

Research work

The research work has been focussed on the response of the turbulent eddy structure near the wall to imposed oscillations. This work corresponds to item 5 of the revised statement of work.

A set of data of simultaneous measurements of wall shear stress and velocity at $y^+ = 15$ has been collected with the following features.

- . centerline time-mean velocity and Reynolds number :
18 cm/s ; $Re_h = 9000$; $u_z = 0.85$ cm/s
- . flow oscillations :
centerline amplitude : 20 %
periode(s) : 2.6. ; 3.17 ; 4 ; 7 ; 28 ; 119 ;
corresponding values of frequency parameter :
 $l^+ : 7 ; 8 ; 9 ; 12 ; 24 ; 50$
- . centerline amplitude 10 % ; $l^+ = 7, 9$
- . sampling frequency : 500 hz
- . record length ~ 30 min. i.e. $\sim 9 \cdot 10^5$ samples

The data analysis is in progress. The first question of concern is the modulation of the bursting process during the cycle. This is a complex question because the variations of the appropriate time scale is unknown owing to the finite time response of various turbulent mechanisms which generate time lags and because burst detection schemes such as VITA which has been used thus far, require a time scale in addition to a velocity scale.

In order to avoid this difficulty the u' -level detection scheme has been

implemented and adapted to unsteady periodic flows. By comparing the results obtained with the two schemes the best time scale for the VITA method is determined.

PAPERS ACCEPTED AT SCIENTIFIC CONFERENCES

- Response of near-wall turbulence to imposed velocity oscillations
by S. TARDU and G. BINDER
to be presented at the XVIIth International Congress of Theoretical and Applied Mechanics in Grenoble, France, from August 21 to 26, 1988
- Some features of the response of wall turbulence to imposed velocity oscillations
by S. TARDU, G. BINDER, R. RONNEBERGER
to be presented at the 2nd European Turbulence Conference in BERLIN from August 30 to September 2, 1988

RESEARCH PLANS

1. Continuation of the analysis of the eddy structure data
Determination of modulations of higher order statistics of u' and v' and of small scale characteristics such as Taylor micro-scale and skewness of du'/dt
2. Collect data on wall shear-stress in adverse pressure gradient with hot film gages for various X-positions, various frequencies and amplitudes of oscillations, two diffuser angles
3. Take velocity measurements with LDA and hot film anemometry to determine amplitude and phase variations of oscillating velocity and turbulence.



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ANNEX

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